EURENCO
GROUPE SNPE

NTO FOR INSENSITIVE COMPOSITIONS

G. ECK, C. SONGY, L. MINGUET

UNIQUE KNOW-HOW

MULTIFACETED RANGE

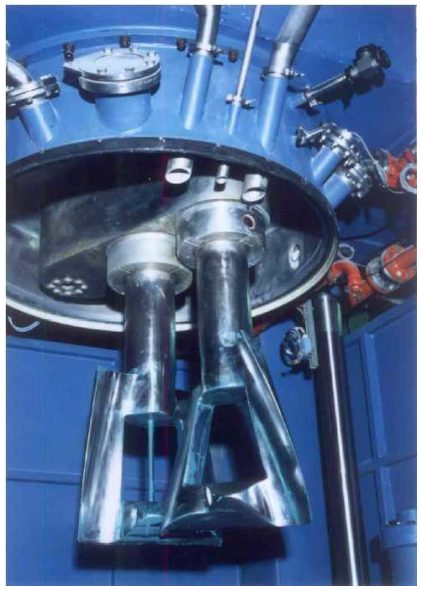
NTO FOR INSENTITIVE COMPOSITIONS

- **Introduction**
- **NTO based compositions for pressed application**
- **NTO based compositions for melt cast application**
- **Conclusion**

NTO FOR INSENTITIVE COMPOSITIONS

INTRODUCTION

Reduction of sensitivity



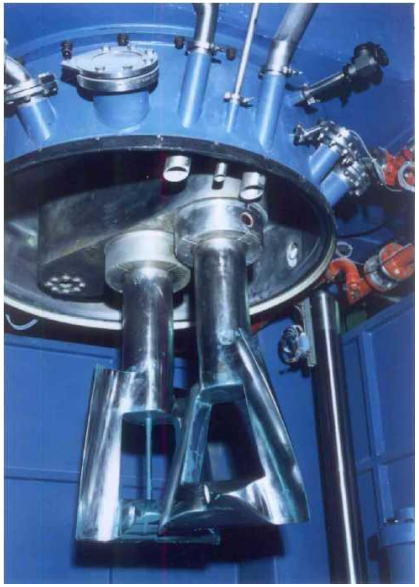
CAST CURED COMPOSITIONS

- **Intrinsic reduced sensitivity**
- **Ease of access to complex geometry**
- **Good mechanical properties**
- **Wide usable thermal operational range**

NTO FOR INSENTITIVE COMPOSITIONS

INTRODUCTION

Reduction of sensitivity

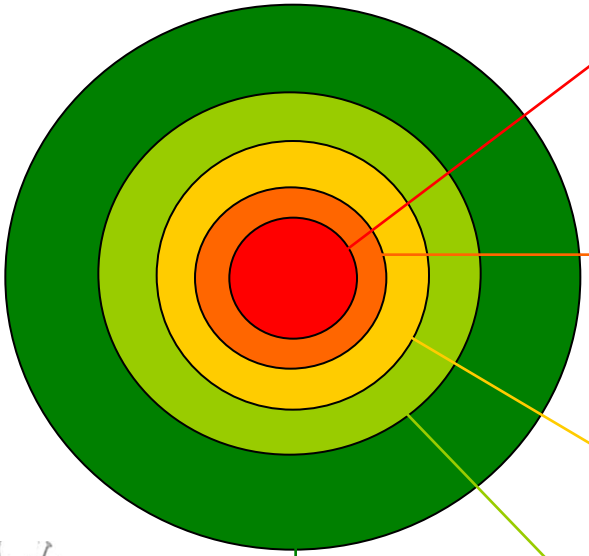


CAST CURED COMPOSITIONS

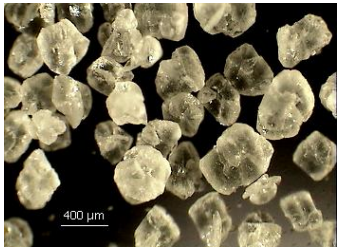
PRESSED COMPOSITIONS
MELT CAST COMPOSITIONS

INTRODUCTION

Insensitive Munitions (IM) are to be considered as a whole



Explosive



Composition

Ammunition
(Design , venting…)

Packaging

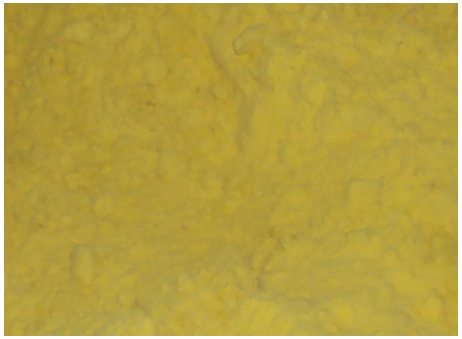
Storage

NTO FOR INSENTITIVE COMPOSITIONS

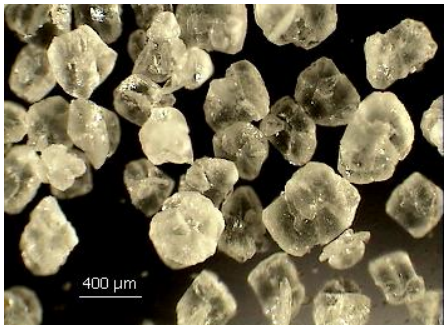
INTRODUCTION

Insensitive compositions may be based on :

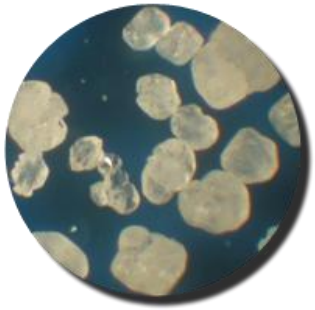
- **TATB**



- **NTO**



- **GUDN or FOX 12**



- **DADNE or FOX 7**

NTO FOR INSENTITIVE COMPOSITIONS

- Introduction
- NTO based compositions for pressed application
- NTO based compositions for melt cast application
- Conclusion

NTO FOR INSENTITIVE COMPOSITIONS

PRESSED APPLICATION
Strategy

PRODUCTION OF NTO BASED COMPOSITIONS

↓

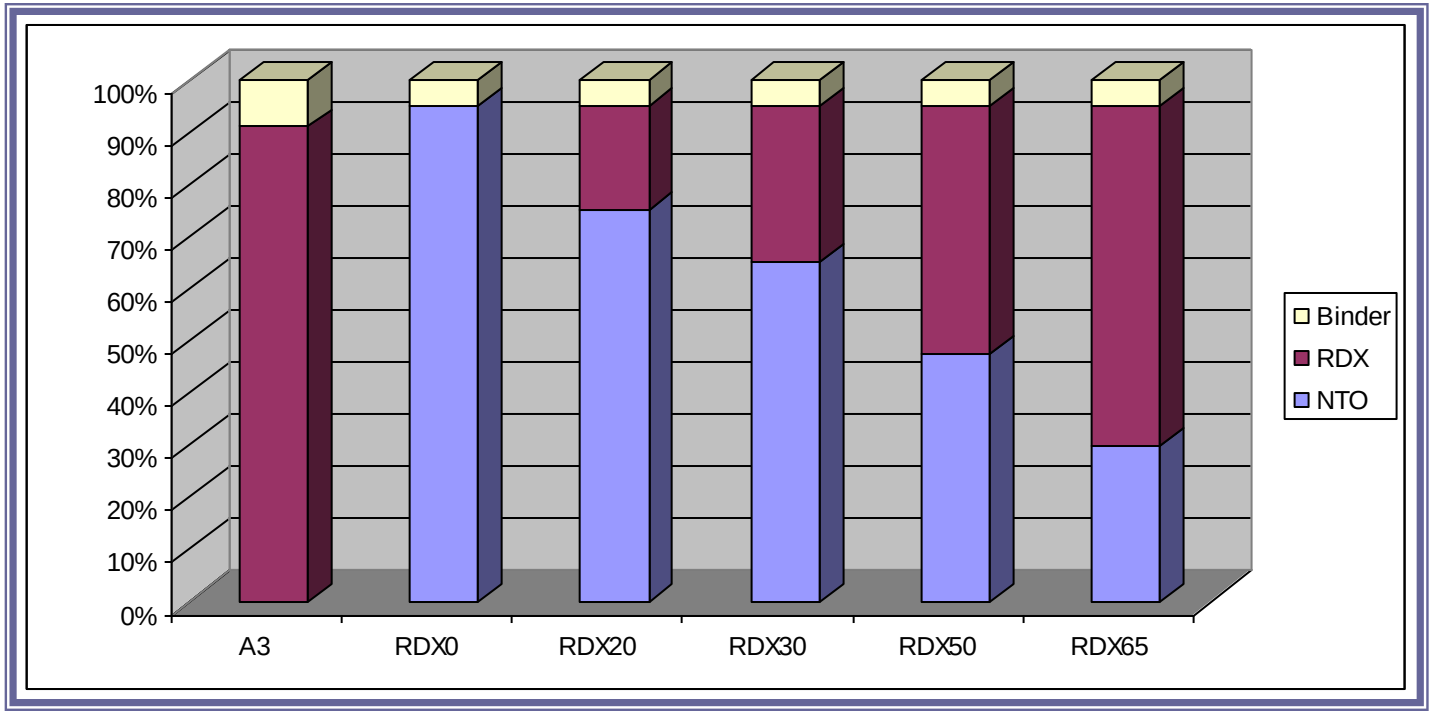
FIRST CHARACTERIZATIONS
Safety, performance, behaviour towards shock, functional

↓

CHOICE OF A COMPOSITION
To be fully characterized

NTO FOR INSENTITIVE COMPOSITIONS

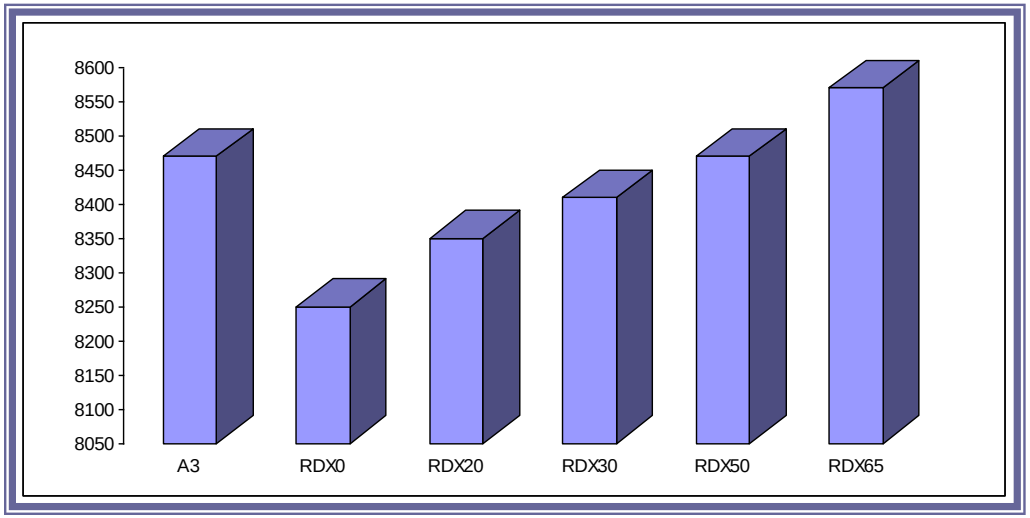
PRESSED APPLICATION
Production of compositions



NTO FOR INSENTITIVE COMPOSITIONS

PRESSED APPLICATION Performance

DETONATION VELOCITY



CRITICAL DIAMETER

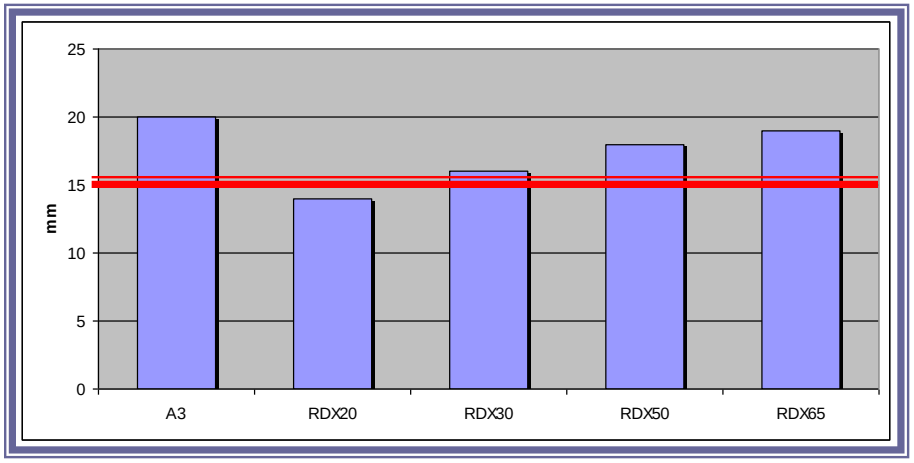
	Critical diameter (mm)
A3	2.2
RDX0	> 20
RDX20	5-7
RDX30	< 5
RDX50	< 5
RDX65	< 5

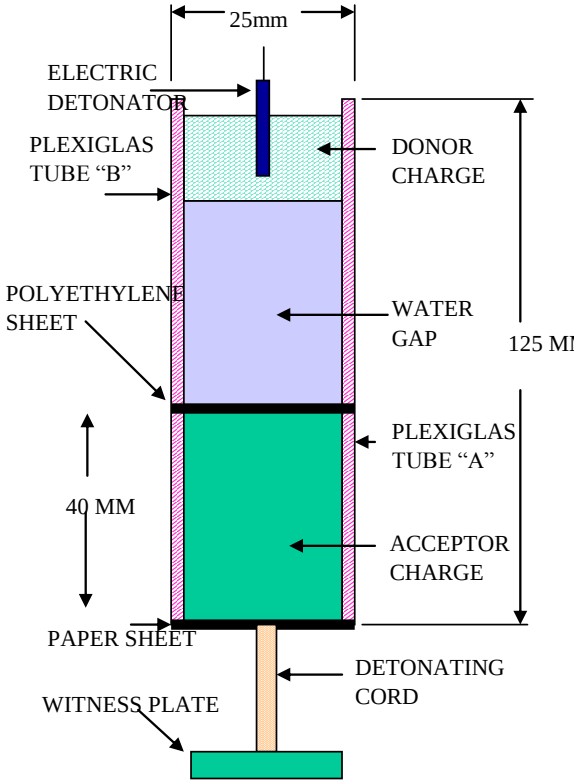
NTO FOR INSENTITIVE COMPOSITIONS

PRESSED APPLICATION
Behaviour towards shock

SSWGT

	SSWGT (mm)
A3	≈ 20
RDX0	No go
RDX20	14
RDX30	16
RDX50	18
RDX65	19





NTO FOR INSENTITIVE COMPOSITIONS

PRESSED APPLICATION
Mechanical properties

	Stress (MPa)	Strain (%)
A3	7.0	6.0
RDX20	8.6	5.2
RDX30	7.9	6.9
RDX50	7.3	6.6
RDX65	6.5	6.3

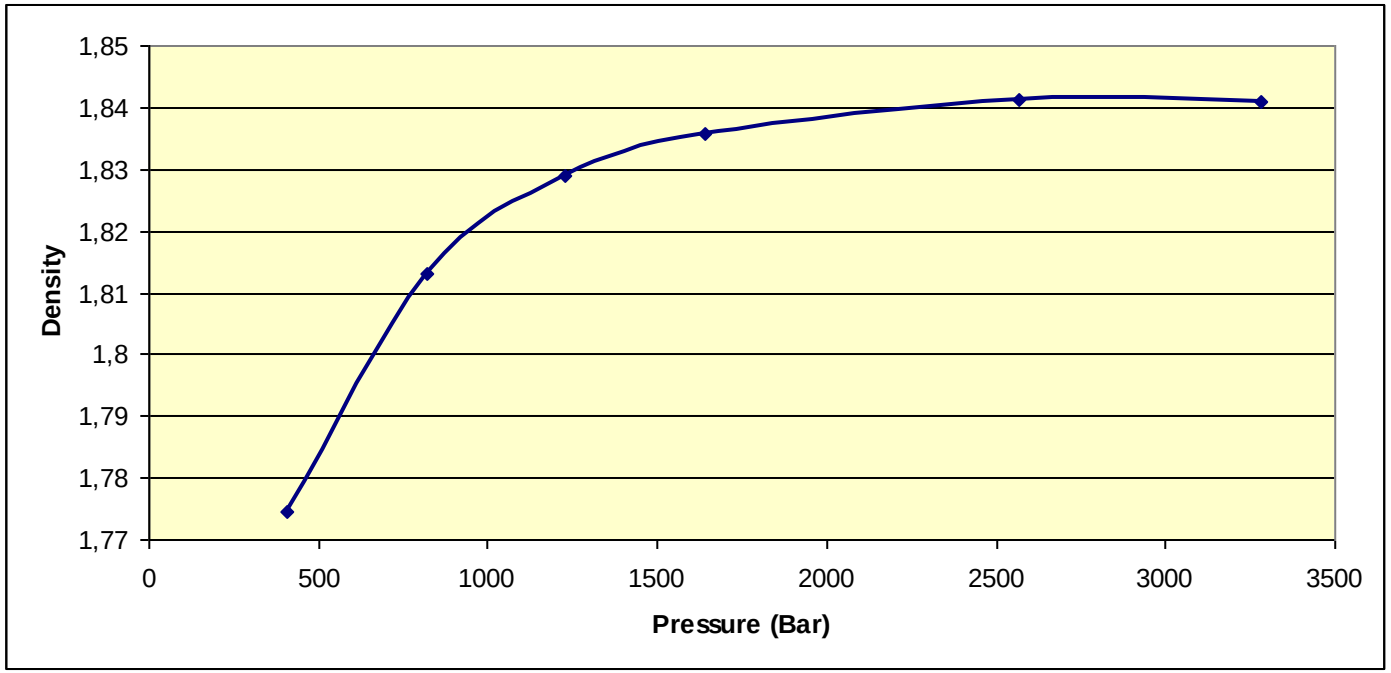
The mechanical properties are comparable

NTO FOR INSENTITIVE COMPOSITIONS

PRESSED APPLICATION Mechanical properties

Compressibility of RDX20

- Max density : 1.84
- % TMD : 98

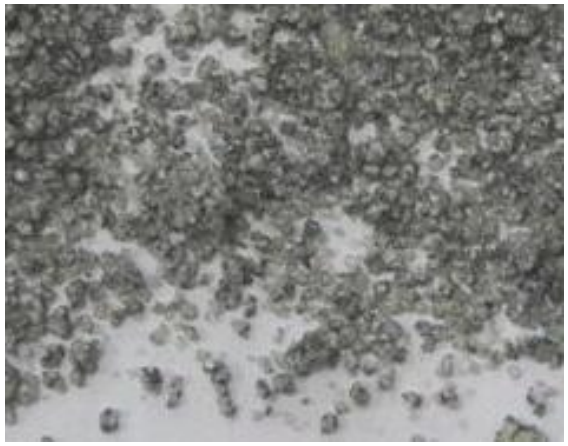


PRESSED APPLICATION Conclusion

RDX20 = The best compromise between insensitiveness and performance

→ **EURENCO COMPOSITION P16945**

	Composition A3	P16945 = RDX20
Critical diameter (mm)	2.2	5-7
Detonation velocity (m/s.)	8470	8350
PCJ (GPa)	29.9	29.7
SSWGT	≈ 20	14
Stress (MPa) Strain (%)	7.0 6.0	8.6 5.2



NTO FOR INSENTITIVE COMPOSITIONS

- Introduction
- NTO based compositions for pressed application
- NTO based compositions for melt cast application
- Conclusion

NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION Introduction

NTO BASED MELT CAST COMPOSITIONS

NON ALUMINIZED COMPOSITIONS

	Density	Detonation Velocity (m/s)
NTO/TNT 50/50	1.654	7370
NTO/TNT 60/40	1.78	7427
NTO/TNT 65/35	1.80	7810

ALUMINIZED COMPOSITIONS

	Density	Detonation Velocity (m/s)
AFX 644	1.71	6820
XF 13333	1.754	7150

→ **Viscosity problem with high NTO contents**

NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
High quality grade of NTO

STANDARD NTO

- **Crystallized NTO : Coarse**
- **Air milled NTO : Fine**

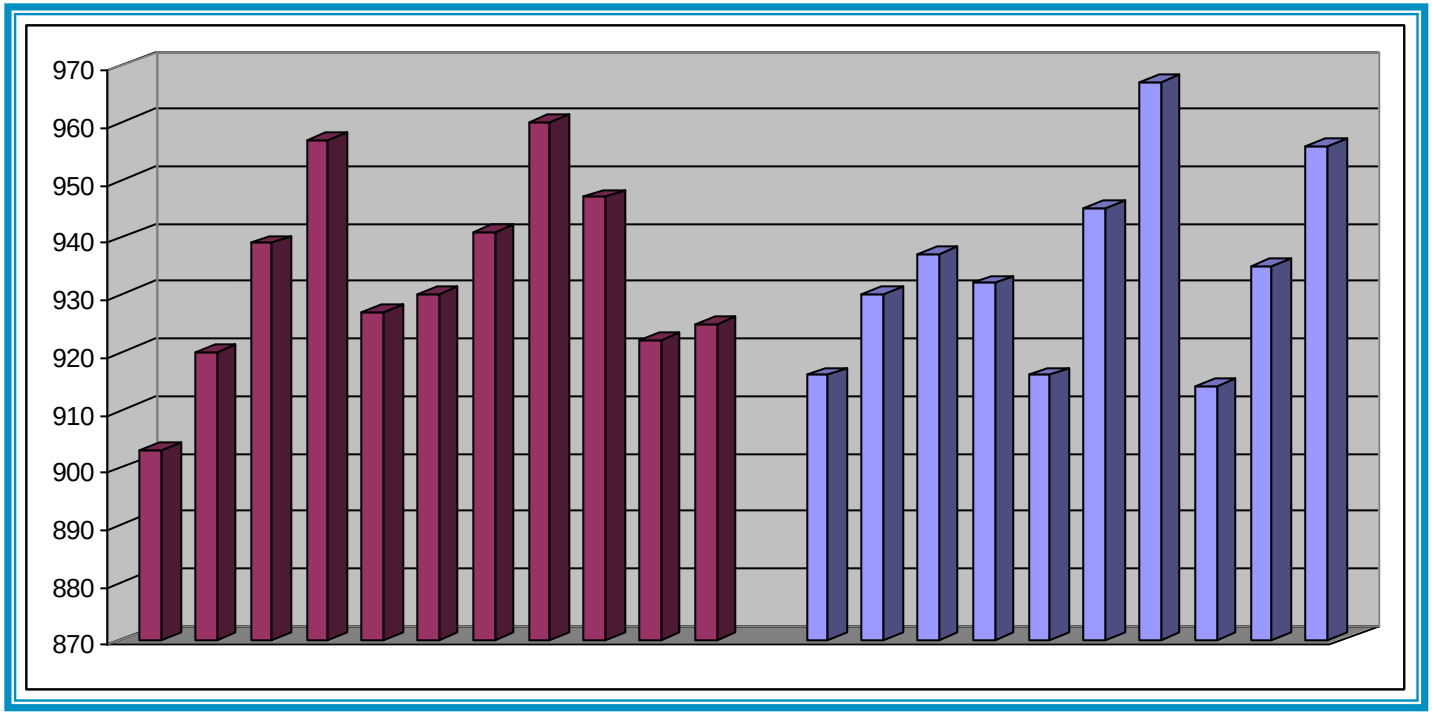
HIGH QUALITY GRADE NTO

- **Crystallized according to a controlled crystallization process**
- **Bulk density and morphology fully controled from the pilot scale to the industrial scale**

NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
High quality grade of NTO

BULK DENSITY



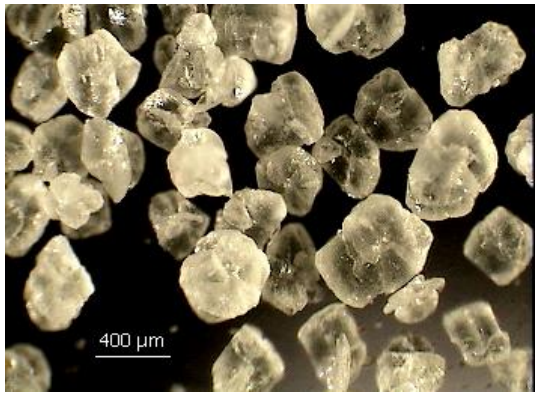
Pilot scale
- **Average : 934 kg/m³**
- **Standard deviation : 17**

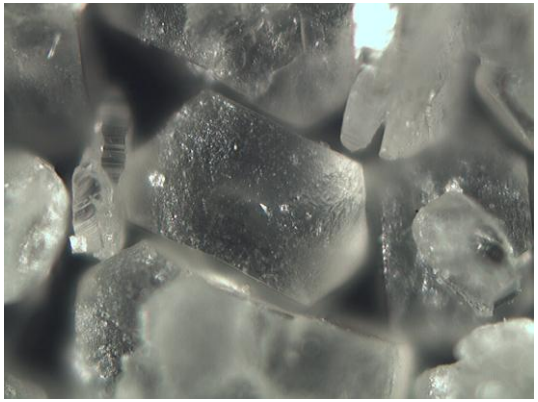
Industrial scale
- **Average : 935 kg/m³**
- **Standard deviation : 18**

NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
High quality grade of NTO

MORPHOLOGY





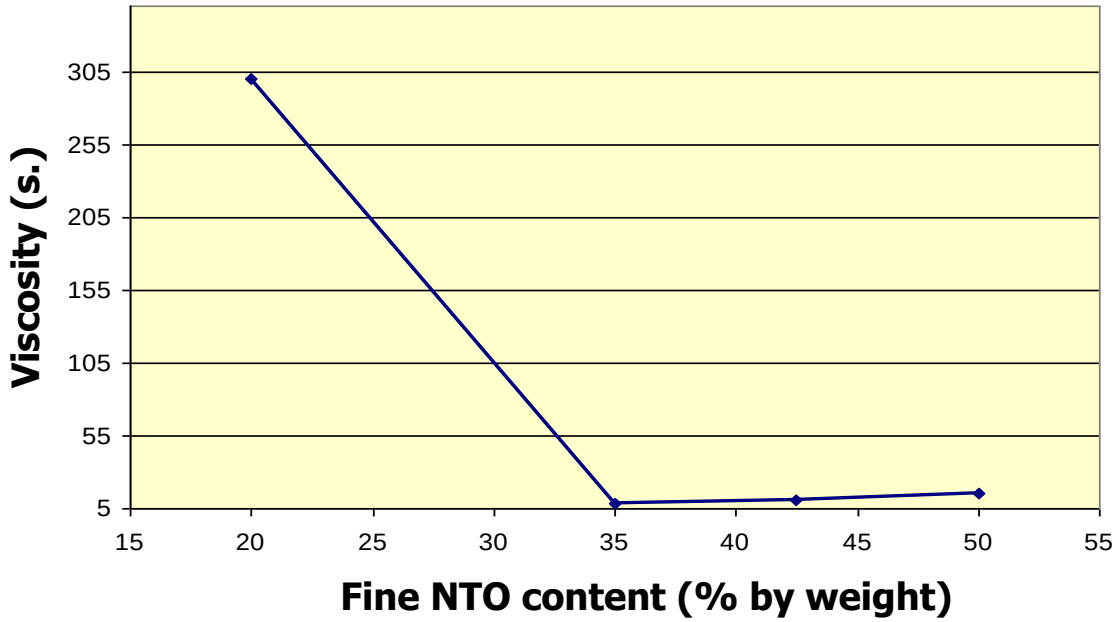
NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
Use of NTO CF in Ontalite 65/35

- **Viscosity is very dependant on the ratio between the coarse and fine fraction**
- **Best ratio Coarse/fine = 65/35**

Coarse : NTO CF

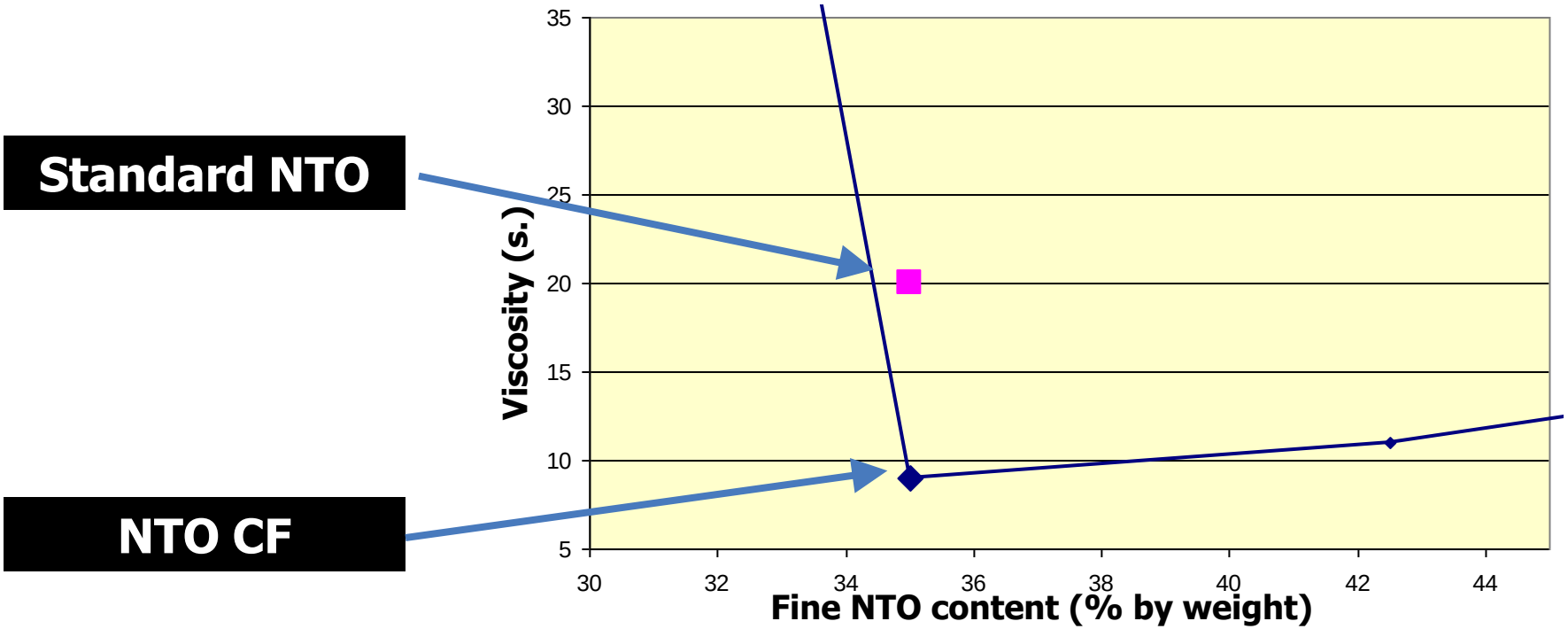
Fine NTO : Class 3



NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
Use of NTO CF in Ontalite 65/35

- **If NTO CF is replaced by Standard NTO, the viscosity is more than twice higher**

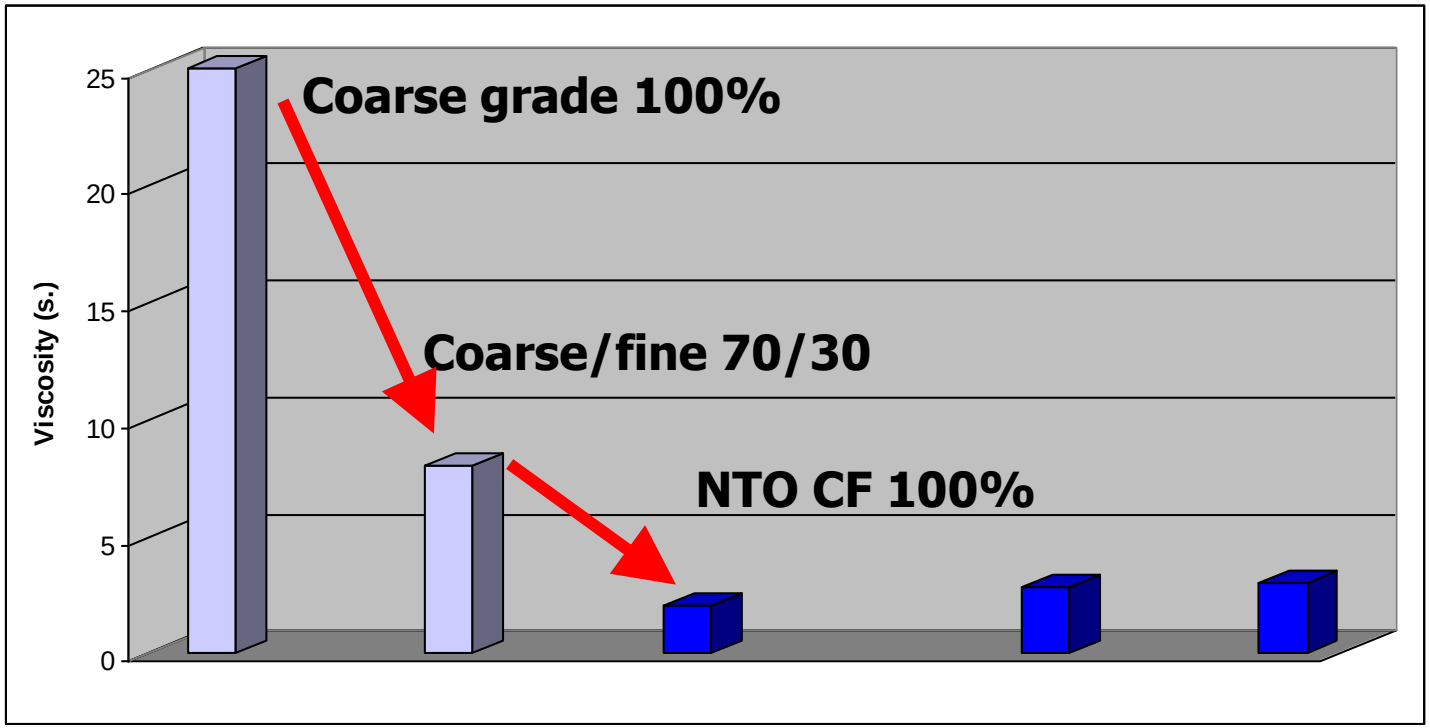


MELT CAST APPLICATION
Use of NTO CF in aluminized Ontalite

- Efflux viscosity measurement on aluminized Ontalite NTO/TNT/Al/Wax : 40/30/20/10
- Comparison of results obtained with standard NTO and NTO CF

NTO FOR INSENTITIVE COMPOSITIONS

MELT CAST APPLICATION
Use of NTO CF in aluminized Ontalite

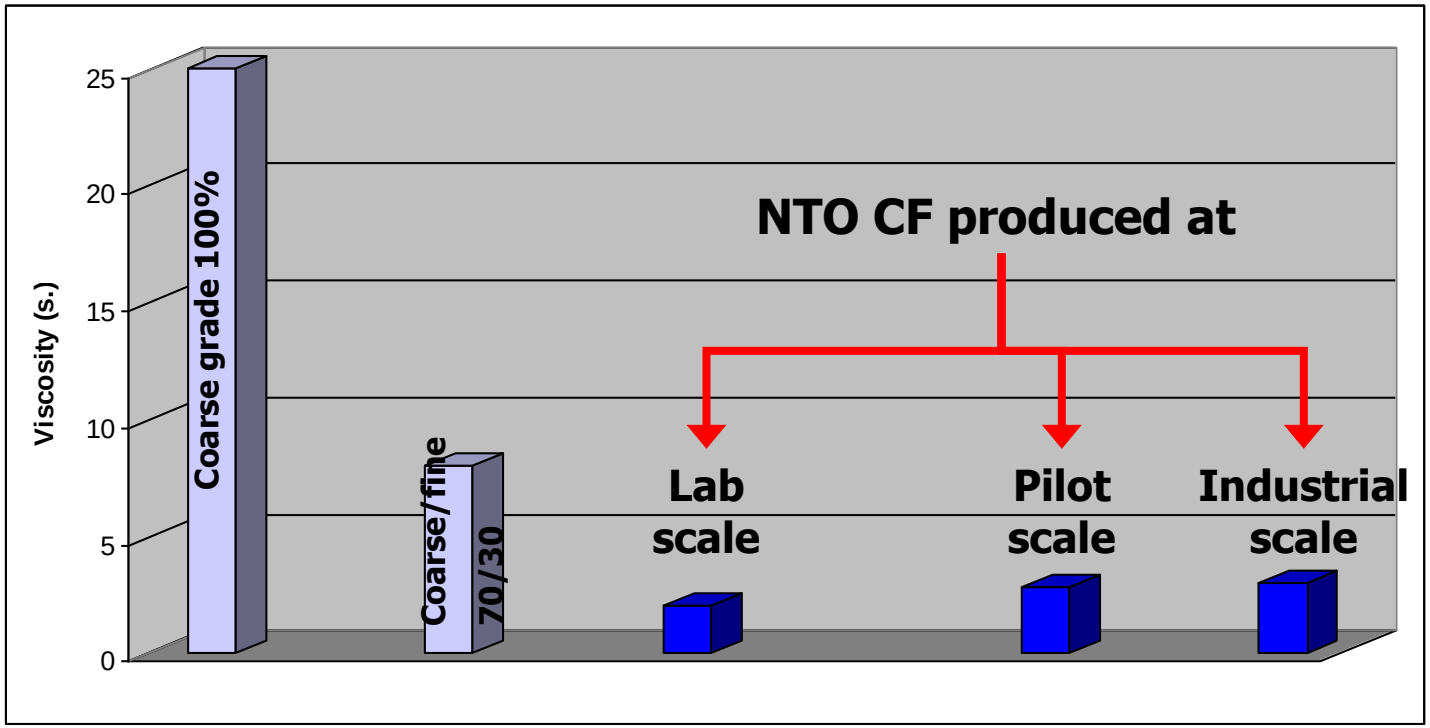


Standard NTO

NTO CF

NTO FOR INSENTITIVE COMPOSITIONS

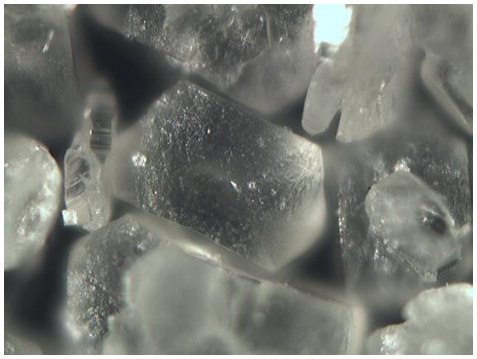
MELT CAST APPLICATION
Use of NTO CF in aluminized Ontalite



Standard NTO

NTO CF

MELT CAST APPLICATION
Conclusion



- **EURENCO produces a new high grade of NTO, NTO CF**
- **NTO CF has been proved to be suitable for melt cast application as well as for compositions based on NTO and TNT or compositions based on NTO, TNT and aluminum**

NTO FOR INSENTITIVE COMPOSITIONS

- Introduction
- NTO based compositions for pressed application
- NTO based compositions for melt cast application
- **Conclusion**

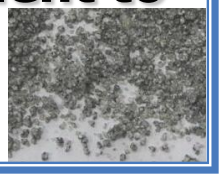
NTO FOR INSENTITIVE COMPOSITIONS

GENERAL CONCLUSION

PRESSED APPLICATION

COMPOSITION P 16945

- **Based on NTO, RDX and a binder**
- **Best compromise between insensitiveness and performance**
- **Performance equivalent to composition A3**



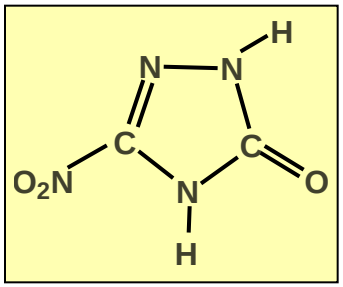
MELT CAST APPLICATION

NTO CF a new high grade of NTO

- **High bulk density NTO**
- **Control morphology of NTO**
- **Significant improvement of the viscosity of Ontalite**
- **Suitable as well as for aluminized or non aluminized Ontalites**

A special thank for their contribution to :

- **C. SONGY and L. MINGUET who coauthored this work**
- **D. LEGEAY and his team**
- **S. MOREAU and S. POUDENX for the industrial scale**



EURENCO
GROUPE SNPE

A MEMBER OF